⑲日本国特許庁（JP）　⑪実用新案出願公開

⑫公開実用新案公報（U）　平4−31299

⑤Int. Cl.⁵	識別記号	庁内整理番号
H 05 B 33/26		8815−3K
G 09 G 3/30	Z	9176−5G
H 05 B 33/04		8815−3K
33/08		8815−3K

⑬公開　平成4年(1992)3月13日

審査請求　未請求　請求項の数 1　（全2頁）

⑭考案の名称　EL表示装置

⑳実　願　平2−71584
㉒出　願　平2(1990)7月6日

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㉗実用新案登録請求の範囲

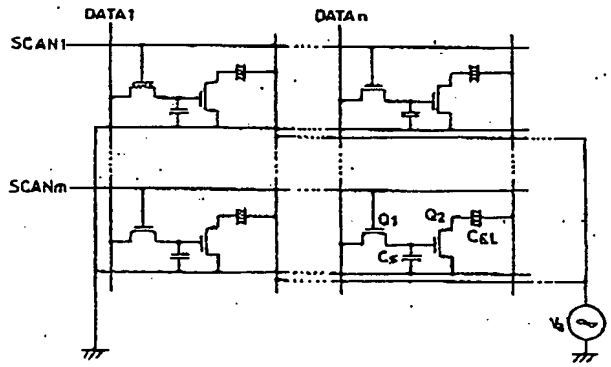
EL発光素子を形成したEL基板と、薄膜トランジスタ、コンデンサ、配線を形成したTFT基板とを、前記EL基板の電極と前記TFT基板の電極とが接続バンプを用いて接続されるように貼り合わせて形成したことを特徴とするEL表示装置。

図面の簡単な説明

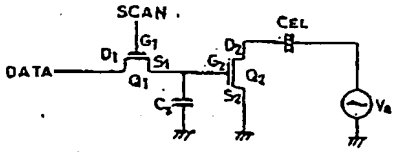
第1図は本考案の一実施例に係るEL表示装置の等価回路図、第2図は1ビット分のEL駆動回路図、第3図はEL表示装置の部分的断面説明図、第4図はEL表示装置の外観図、第5図は分離状態を示す外観図、第6図は従来の1ビット分の平面説明図、第7図は従来のEL表示装置の部分的断面説明図である。

1……基板、11……EL基板、12……透明電極、13……第1の絶縁層、14……発光層、15……第2の絶縁層、16……金属電極、21……TFT基板、22……ゲート電極、23……ゲート絶縁層、24……半導体活性層、25……チャネル保護膜、29……パシベーション膜、30……ソース電極、31……ドレイン電極、32……SCAN用電極、33……DATA用電極、34……グランド部、35……透明電極接続用電極、36……接続バンプ、37……透明電極引き出し部。

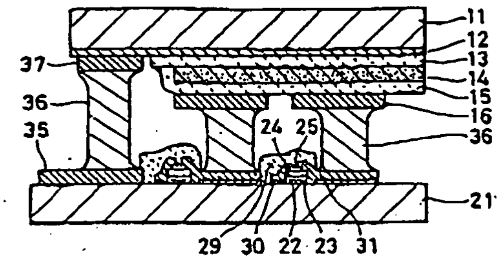
第1図



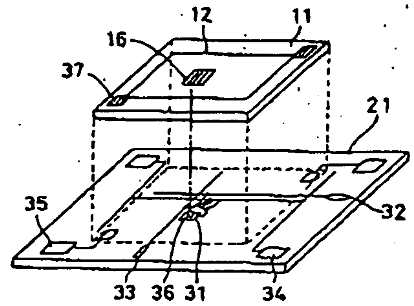
第2図



第３図



第５図



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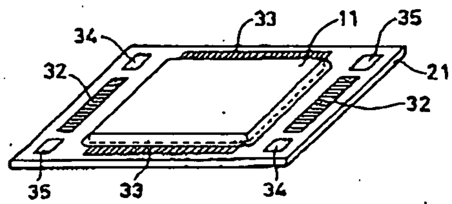
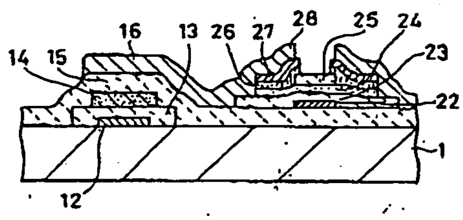
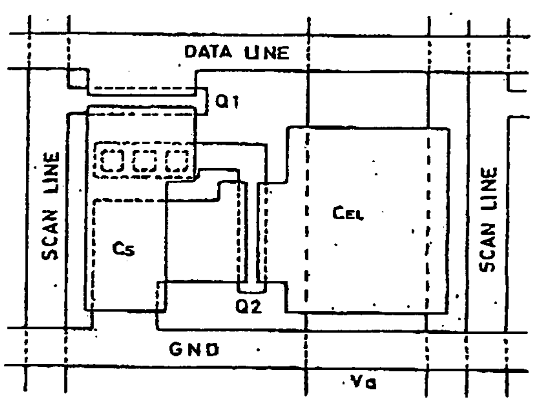


第７図



第６図



(11) Japanese Unexamined Utility Model Registration Application Publication No. 4-31299
(43) Publication Date: March 13, 1922
(21) Application No. 2-71584
(22) Application Date: July 6, 1990
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SPECIFICATION

1. Title of the Invention: EL DISPLAY DEVICE

2. Claim

An EL display device formed by affixing an EL substrate having an EL light emitting element formed thereon and a TFT substrate with a thin film transistor, a capacitor, and a wire formed thereon to each other so that an electrode of the EL substrate is connected to an electrode of the TFT substrate by using a connection bump.

Detailed Description of the Device

Correction by ex officio

3. Detailed Description of the Invention

(Technical Field of the Device)

The present device relates to an EL display device to drive an EL light emitting element by the switching control of a thin film transistor (TFT), and, in particular, it relates to an EL display device capable of realizing high image quality by increasing the aperture ratio (area of one pixel of a light emitting part in one pixel / area of one pixel) when realizing high fineness.

(Description of the Related Art)

The EL display of the thin film transistor (TFT) drive consists of a matrix type drive circuit, and a plurality of drive circuits for one pixel (one bit) are arranged in the vertical direction and in the right-to-left direction. The EL display device is driven by driving a drive circuit of each pixel by signal lines formed in a matrix.

As components in one pixel (one bit) of the EL display device, as shown in a plan schematic representation for one bit in Fig. 6, components such as an EL light emitting element C EL, a first switching element Q1 and a second switching element Q2 of a thin film transistor (TFT), a capacitor Cs, and wires (SCANLINE, DATALINE, GND and Va) are formed on the same substrate formed of glass or the like (A66-in 20-lpi Electroluminescent Display Panel T. P. Brody, F. C. Luo, et al., IEEE Trans. Electron Devices,. Vol. ED-22, No.9, Sept. 1975, p739 to p749).

Further, regarding a manufacturing method of a known EL

display device, as shown in a partial sectional schematic representation of the EL display device in Fig. 7, a transparent electrode 12 of an EL light emitting element, a first insulation layer 13, a light emitting layer 14, and a second insulating layer 15 are firstly formed on a same substrate 1. Secondly, a gate electrode 22 of a thin film transistor (TFT), a gate insulating layer 23, a semi-conductor active layer 24, a channel protective film 25, an ohmic contact layer 26, a diffusion preventive layer 27 are formed thereon, and further, a metal electrode 16 of the EL light emitting element and a wiring metal layer 28 of the TFT are formed thereon.

Still further, in a manufacturing method of another known EL display device, a TFT part is formed first on a substrate, and an EL light emitting element part is formed thereafter.

(Problems to be Solved by the Device]

However, in the configuration of the known EL display device, there occurs a problem, in that, when realizing high fineness, the light emitting area ratio in one pixel, in other words, the aperture ratio (area of a light emitting part in one pixel / area in one pixel) is reduced, and the image quality is degraded.

Further, in order to increase the aperture ratio, it is necessary to realize high fineness of the TFT part, the

capacitor part and the wiring part other than the EL light emitting element part, and in this situation, a problem occurs, in that the yield is degraded.

Still further, in the manufacturing method of the known EL display devices, since both the EL light emitting element and the TFT are formed on the same substrate, a problem occurs, in that the manufacturing process becomes complicated, and the yield is reduced.

The present device is achieved in light of the above-described situation, and an object of the device is to provide an EL display device capable of increasing the aperture ratio and realizing high image quality when realizing high fineness.

(Means for Solving the Problems)

In order to solve the problem of the known example, the present device is characterized in that an EL display device is formed by affixing an EL substrate having an EL light emitting element formed thereon, and a TFT substrate with a thin film transistor, a capacitor, and a wire formed thereon to each other so that an electrode of the EL substrate is connected to an electrode of the TFT substrate by using a connection bump.

(Operation)

According to the present device, an EL substrate having and EL light emitting element formed thereon, a thin film

transistor (TFT), a capacitor, and a TFT substrate having a wire or the like arranged thereon are formed on separate substrates, respectively, and affixed to each other to obtain an EL display device so that the electrodes of the respective substrates are connected to each other by using a connection bump. When realizing high fineness, the area of a light emitting part in one pixel can be ensured wide on an EL substrate without being interfered with the TFT, the capacitor, the wire or the like. Thus, the aperture ratio can be increased to realize high image quality. Further, reduction of the yield can be prevented without complicating any design rules or the manufacturing process.

(Embodiments)

An embodiment of the present device will be described below with reference to the drawings.

Fig. 1 shows an equivalent circuit of an EL display device of the present embodiment.

The EL display device is a matrix type drive circuit having the bit number of m × n. A plurality of drive circuits of one pixel are arranged in the vertical direction and in the right-to-left direction, a gate terminal of a first switching element Q1 of each drive circuit arranged in the right-to-left direction is connected to a switching signal line Y so as to provide a switching signal SCAN, and a drain terminal of the first switching element Q1 of each

drive circuit arranged in the vertical direction is connected to an information signal line X to provide the light emission signal DATA. The EL drive power supply voltage Va is applied to one end of an EL light emitting element C EL, and one end of a capacitor Cs is connected to the ground level.

Next, the EL drive circuit for one bit of the equivalent circuit of the EL display device will be described with reference to the EL drive circuit diagram in Fig. 2.

The EL drive circuit comprises a first switching element Q1 consisting of a thin film transistor (TFT), a second switching element Q2 consisting of a capacitor Cs for storage with one terminal connected to a source terminal S1 side of the switching element Q1, and a TFT in which a gate terminal G2 is connected to a source terminal S1 of the first switching element Q1, and a source terminal S2 is connected to the other terminal of the capacitor Cs for storage, and an EL light emitting element C EL in which one terminal is connected to a drain terminal D2 of the second switching element Q2, and the other terminal is connected to the EL drive power supply Va.

The first switching element Q1 is turned on according to the switching signal SCN applied to the gate terminal G1, and charges/discharges the capacitor Cs for storage

according to the light emission signal DATA by turning ON/turning OFF the first switching element Q1. The second switching element Q2 is turned ON by applying the hold voltage of the capacitor Cs for storage to the gate terminal G2, and allows the EL light emitting element C EL to emit light by the EL drive power supply Va. When the second switching element Q2 is turned OFF, the drain terminal D2 side of the EL light emitting element C EL is in a floating state, resulting in a non-light-emitting state.

As described above, the EL display device is displayed by the line sequential scanning system by the SCAN signal.

Next, the configuration of the EL display device will be described with reference to the partial sectional schematic representation in Fig. 3 and an overall view of Fig. 4.

As shown in Fig. 3, the EL display device of the present embodiment is manufactured by separately manufacturing an EL substrate 11 with an EL light emitting element formed thereon, a thin film transistor (TFT), a capacitor Cs, a switching signal line Y (a SCAN line) with the SCAN signal given thereto, an information signal line X (a DATA line) with the DATA signal given thereto, and a TFT substrate 21 with a ground line (a GND line) formed thereon, positioning them, and affixing them to each other in a heated and pressurized state so that an electrode of the EL

substrate 11 is connected to an electrode of the TFT substrate 21 by using a connection bump of low melting point and the glass substrate side forms an outer side.

In addition, the periphery of both affixed substrates is sealed with resin. In this situation, when nitrogen gas (N2) is filled inside, the temperature resistance is improved, the reliability is enhanced, and the lifetime is prolonged.

Next, the specific configuration of the EL light emitting element C EL formed on the EL substrate 11 will be described. A transparent electrode 12 of indium oxide tin (ITO) or the like, a first insulation layer 13 of silicon nitride film (SiNx), a light emitting layer 14 of zinc sulfide (ZnS), a second insulating layer 15 of SiNx, and a metal electrode 16 of an alloy consisting of aluminum (Al), nickel (Ni), and copper (Cu) are successively laminated on the EL substrate 11 formed of glass or the like.

Further, the specific configuration of the thin film transistor (TFT) formed on the TFT substrate 21 will be described.

A gate electrode 22 of chromium (Cr), a gate insulating layer 23 of silicon nitride film (SiNx), a semi-conductor active layer 24 of amorphous silicon (a-Si), and a channel protective film 25 of SiNx are successively laminated on the TFT substrate 21, a source electrode 30 and a drain

electrode 31 are formed of aluminum (Al) or the like across the channel protective film 25, and a passivation film 29 is formed to protect the TFT.

On the TFT substrate 21, wires such as the SCAN line, the DATA line and the GND line are formed, and an electrode 32 for SCAN, an electrode 33 for DATA, a ground part 34, and an electrode 35 for connecting the transparent electrode are formed on a peripheral part of the TFT substrate 21.

As described above, how these separately formed EL substrate 11 and TFT substrate 21 are affixed to each other will be described with reference to the overall view to show the separate state of both substrates in Fig. 5.

Firstly, in order to connect the metal electrode 16 of the EL light emitting element C EL to the drain electrode 31 of the TFT switching element Q2, a connection bump of low melting point is formed on either electrode. According to the present embodiment, a connection bump 36 of low melting point is formed on an upper portion of the drain electrode 31 part of the TFT switching element Q2 on the TFT substrate 21 is formed. A material of the connection bump 36 consists of Pb/Sn (an alloy of lead and tin), and is formed by a plating method, a vapor deposition method, a solder dip method or the like.

Both substrates are positioned so that the TFT substrate 21 is on a lower side, and the glass substrate of

the EL substrate 11 is on an upper side, and the EL substrate 11 is placed thereon. By pressurizing the substrates against each other in a heated condition at 180°C to 220°C, the TFT substrate 21 is connected to the EL substrate 11.

The transparent electrode extraction part 37 connected to the EL drive power supply Va in the EL substrate 11 is connected to the electrode on the TFT substrate 21 by the similar connection bump 36, extracted to the electrode 35 for connecting the transparent electrode of the TFT substrate 21, and further extracted outside. In Fig. 5, the electrodes are arranged in a diagonal manner.

As described above, in one pixel of the above-described EL display device, the area part of the electrodes for the connection bump on the drain electrode D2 side of the DATA line, the SCAN line, the GND line, the switching elements Q1 and Q2, the capacitor Cs and the switching element Q2 which has formed the pixel pitch restriction is formed on the TFT substrate 21 in the present embodiment, and in comparison with a case of the EL display device in the conventional two-dimensional arrangement on the same substrate, the line for the EL drive power supply Va can be omitted. Still further, a smaller area of the electrode for the connection bump of the present embodiment is acceptable in comparison with the area of the EL pad of the known EL light emitting

element (a pad on the drain electrode side of the known switching element Q2), and the difference therebetween can be finer.

In addition, a three-dimensional arrangement is employed in the present embodiment, and the best aperture ratio can be set at the pixel pitch in the TFT substrate.

According to the EL display device of the present embodiment, the EL substrate 11 and the TFT substrate 21 are separately formed, and electrodes of both substrates are connected to each other by the connection bump 36, the relatively wide area of the light emitting part can be ensured on the EL substrate 11, an aperture in one pixel can be increased in size, the light emission quantity can be increased while the drive power is left substantially unchanged from the conventional value, and the high image quality can be obtained.

In addition, since the EL element unit and the TFT part are formed on separate substrates, respectively, the process of the conventional technology can be used as it is, the process is easier than the process of the integrated type, and an increase of the yield can be expected.

(Advantages)

According to the present device, the EL substrate having the EL light emitting element formed thereon and the TFT substrate having the thin film transistor (TFT), the

capacitor, the wire or the like formed thereon are formed on separate substrates, respectively, and affixed to each other to obtain the EL display device so that the electrodes on the substrates are connected to each other by using the connection bump. Thus, when realizing high fineness, the area of the light emitting part in one pixel can be ensured wide on the EL substrate without being interfered by the TFT, the capacitor, the wires, or the like, the aperture ratio can be increased, and high image quality can be obtained. Further, reduction of the yield can be prevented without complicating the design rules or the manufacturing process.

4. Brief Description of the Drawings

Fig. 1 shows an equivalent circuit of an EL display device according to an embodiment of the present device, Fig. 2 is a view of an EL drive circuit for one bit, Fig. 3 is a schematic representation of a partial section of the EL display device, Fig. 4 is an overall view of the EL display device, Fig. 5 is an overall view to show a separated state, Fig. 6 is a conventional plan schematic representation for one bit, and Fig. 7 is a schematic representation of a partial section of a conventional EL display device.

1 ... ... substrate

11 ... ... EL substrate

12 ... ... transparent electrode

13 ... ... first insulating layer

14 ... ... light emitting layer

15 ... ... second insulating layer

16 ... ... metal electrode

21 ... ... TFT substrate

22 ... ... gate electrode

23 ... ... gate insulating layer

24 ... ... semi-conductor active layer

25 ... ... channel protective film

29 ... ... passivation film

30 ... ... source electrode

31 ... ... drain electrode

32 ... ... SCAN electrode

33 ... ... DATA electrode

34 ... ... gland part

35 ... ... electrode for connecting transparent electrode

36 ... ... connection bump

37 ... ... transparent electrode extension part

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